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CONTENTS

Twenty-eighth National Conference on Weights and Measures.
Parking meters.
Pressure losses in pipe bends.
Underground corrosion at industrial plants.
Stray currents in buildings.
Hydrogen-reduction method for the determination of oxygen in steel.
Determination of arsenic, antimony, and tin.
Determinations of oxygen in alloy steels.
Determination of aluminum in nonferrous materials.
Preparation of ammonium aurintricarboxylate.
Chromous solutions for absorption of oxygen in volumetric gas analysis.
Nitrogen in volumetric gas analysis.
Measurement of supervoltage X-rays with free-air ionization chamber.

Combination of hydrochloric acid and sodium hydroxide with hide, tendon, and bone collagen.
Accelerated aging of leather in the oxygen bomb.
Permeability of wrapping materials.
Tentative test for glaze solubility.
Density-composition relations of some soda-potash-silica glasses.
Effect of curing temperature on Young's modulus of concrete.
J. H. Dellinger and G. W. Vinal receive awards.
Errors in Technical News Bulletin.
New and revised publications issued during June 1938.
Mimeographed material: Letter Circulars.
Recent Bureau articles appearing in outside publications.

TWENTY-EIGHTH NATIONAL CONFERENCE ON WEIGHTS AND MEASURES

The Twenty-Eighth National Conference on Weights and Measures was held in Washington on May 31 to June 3, inclusive. Two sessions were held at the Bureau and two at the Hotel Washington, the downtown headquarters of the conference.

The attendance numbered 260 members and guests, the largest on record. Delegates were present from 27 States and the District of Columbia. A considerable number of representatives of firms manufacturing weighing and measuring appliances and others interested in weights and measures matters made up a truly representative gathering.

Dr. Lyman J. Briggs, president of the conference, opened the sessions with a short address in which he commented particularly on the bill now pending in Congress to fix the

standards of weight and measure for the United States.

On special invitation, Hon. Richard C. Patterson, Jr., Assistant Secretary of Commerce, addressed the conference on June 1. He spoke of the value of such gatherings in coordinating the work of Federal, State, and local governmental agencies, and the importance of exact measurements in raising the American standard of living and in promoting foreign trade.

Fifteen formal papers were presented and discussed in addition to the usual committee reports and special demonstrations of weighing and measuring apparatus. Considerable attention was devoted to the testing of wagon and motortruck scales, and a full report was made on the work performed in this field by the National Bureau of Standards in cooperation with the States.

The most important actions of the conference were the adoption of certain changes in the codes of specifications

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and tolerances for vehicle tanks, liquid-measuring devices, and scales; the endorsement of pending Federal bills for the establishment of national units of weight and measure and for standardization of cans for food products; and the decision to study the feasibility of the mandatory standardization of packaged food products.

A special visit to the Bureau's hydraulic laboratory and to most of the laboratories of the Weights and Measures Division was arranged for the afternoon of June 2.

At the final session, on June 3, the following officers were elected for the ensuing year: President, Dr. Lyman J. Briggs, Director, National Bureau of Standards. Vice Presidents: W. S. Bussey, Chief, State Division of Weights and Measures, Austin, Tex.; Rollin E. Meek, Chief, State Bureau of Weights and Measures, Indianapolis, Ind.; Charles C. Read, State Superintendent of Weights and Measures, Trenton, N. J.; C. E. Tucker, Chief, State Division of Weights and Measures, Sacramento, Calif.; B. W. Ragland, Chief, City Bureau of Weights and Measures, Richmond, Va.; Howard E. Crawford, City Inspector of Weights and Measures, Jacksonville, Fla. Secretary, F. S. Holbrook, National Bureau of Standards, Washington, D. C. Treasurer, George F. Austin, Jr., Supervising Inspector, City Bureau of Weights and Measures, Detroit, Mich.

PARKING METERS

At the request of the director of vehicles and traffic of the District of Columbia, the Bureau has made an examination of parking meters. In all, 19 meters, the products of 11 manufacturers, were tested as time-measuring instruments, and for possible defects in mechanical construction. In connection with the work, a large amount of data on the use of these meters was collected. A complete report was made to the director of vehicles and traffic last month, and it is understood that practical experiments with parking meters in service will soon be inaugurated in Washington.

PRESSURE LOSSES IN PIPE BENDS

In even the simplest piping system, the pipes must change direction in many places. Therefore, bends, and particularly 90° bends, are perhaps the most frequently used fittings. As pressure losses in bends are

greater than in the same lengths of straight pipe, the effect of a number of bends in a pipe line is to decrease the flow. To obtain a given flow it is necessary to increase the pipe diameter or to provide more pumping capacity, either of which expedients increases the expense of the installation.

Many experiments have been made to find the exact pressure losses in pipe bends, but the results seem to be very inconsistent. A paper by K. Hilding Beij in the July Journal of Research (RP1110) describes an investigation which forms part of a general program under way at the National Hydraulic Laboratory, to determine the reasons for these inconsistencies, with the ultimate object of developing, if possible, reliable formulas for computing pressure losses in pipe bends.

The experiments concern 90° pipe bends in 4-inch pipe lines. Tests were made on bends varying from 6 to 80 inches in radius. It was found, for bends having a radius of four times the pipe diameter or less, that the results could be brought into agreement with those made by previous experimenters under comparable conditions, provided the roughness of the pipe walls was taken into account. More work was needed, however, to determine the exact relationships, and hence a working formula.

For bends of radius greater than four times the pipe diameter it was found that other unknown, and as yet unpredictable, effects obscure the problem. Until this problem is solved, the designer must use the experimental results which indicate the highest pressure loss in order to be certain that the pipe capacity will be sufficient.

UNDERGROUND CORROSION AT INDUSTRIAL PLANTS

Differences in the electrical potentials of two areas on the same pipe or on two connected pipes may arise from many causes. These result in electric currents which remove metal from one of the areas. Differences of potential are so prevalent that they can be found almost anywhere if a sufficiently sensitive instrument is used. The problem of the corrosion engineer is to determine the significance of these differences of potential.

Corrosion may be the result of stray current electrolysis, segregations in metals, or corrosive soil conditions.

Electrolysis is usually confined to the neighborhood of street-car tracks and substations, and can be identified by the fluctuating nature of the currents flowing on the corroding structure. Corrosion caused by inferior materials is comparatively rare.

If the above possible causes are eliminated, it is safe to assume that observed corrosion is due to soil conditions without testing the soil.

Electrolysis may be reduced by the use of insulating joints or by lowering the potential of the corroding structure below that of the surrounding earth.

Soil corrosion may be reduced by the use of corrosion-resistant metals. These must be selected with respect to the soil conditions they will encounter.

Reinforced bituminous coatings properly applied will also reduce corrosion. It is difficult, however, to apply and maintain a perfect coating.

Corrosion at the imperfections in coatings may be prevented by connecting the corroding metal to the negative side of a source of low potential direct current, and connecting the positive side to a set of suitably placed electrodes. This is known as cathodic protection.

STRAY CURRENTS IN BUILDINGS

At the spring meeting of the American Research Committee on Grounding the technical subcommittee submitted a progress report to the representatives of the 14 national organizations, including the Bureau, which are cooperating in this movement. The report covered six additional field investigations and several sets of laboratory tests.

The first investigation reported was not undertaken because any trouble had been experienced, but because, in the construction of a large building, the electrical isolation of all protective grounds from the piping systems had been attempted. Electrical tests and inspection showed, however, that such isolation had not been attained.

In the second case, the complaint was of leaky water-pipe joints, and the trouble was apparently due to a combination of high water pressure and poor workmanship in the original installation.

In another case where the complaint was of a failure of boiler tubes, steady readings of small direct current were obtained at the boiler, indicating galvanic action. On the pipes and

grounding conductor close to the service entrance the readings were small and fluctuating, indicating stray electric-railway currents.

In the three remaining cases the complaints were of discoloration, or other impairment of the quality of the water delivered through taps on customers' premises. Of these three cases one showed no electric current present on the pipes, another was cleared up by lime treatment of the water, and the third case was remedied by reducing the temperature of the hot water to 140°.

To date the technical subcommittee has investigated some 26 field cases where complaints have been made, and where it was suspected that stray alternating or direct current might have been a factor in producing the trouble. In none of the cases so far investigated, however, has the trouble been found to be due to alternating current on the water-piping system, although, on the other hand, investigations have not shown that such current may not have contributed to the cause of the complaint in some of the cases. A number of significant factors have been found, including the tendency of the water in question to corrode the piping or other metal, the effect of dissimilar metals in the piping system creating galvanic couples, and corrosion of hot-water supply boilers due to abnormally high temperatures. Further field investigations are to be made as cases are reported to the committee by water companies where troubles such as corrosion, impairment of water, sparking, or electrical shock are suspected as being caused by electrical grounding.

Field work is being supplemented by laboratory investigations of the fundamental electrochemical principles involved. It is believed that these will throw considerable light on the causes of the water companies' difficulties.

Laboratory tests on samples of metals simulating pipes have been made. These tests have indicated many factors that enter the problem of the effects of superimposed alternating current on galvanic-cell current, and further tests to determine the fundamentals involved are being undertaken.

HYDROGEN-REDUCTION METHOD FOR THE DETERMINATION OF OXYGEN IN STEEL

The report of the recent cooperative study of methods for the determination of oxygen in steel, sponsored jointly by

the Bureau and the American Institute of Mining and Metallurgical Engineers, has shown the need for further intensive study of some of the methods in order that their accuracy and limitations may be definitely specified. To extend the data on one of these methods a study was made, by John G. Thompson and Vernon C. F. Holm of the Bureau's Metallurgy Division, of the Brower, Larsen, and Shenk modification of the hydrogen-reduction method. As reported in the Journal of Research for July (RP1114), it was found that the method yielded accurate values for the total oxygen content of several plain carbon steels, including steels that contained small amounts of alumina and silica, but yielded low results when larger amounts of alumina were present. The method was not applicable to the determination of the oxygen content of open-hearth iron because of inability to separate surface and body oxygen in this material.

DETERMINATION OF ARSENIC, ANTIMONY, AND TIN

An improved method for the determination of arsenic, antimony, and tin, developed by John A. Scherrer of the Chemistry Division, is described in the Journal of Research for July (RP-1116). In the new procedure arsenic, antimony, and tin are separated from most of the lead in babbitts, type metals, solders, and the like by digestion in hydrofluoric, nitric, and sulfuric acids, and from most of the copper, zinc, lead, etc., in brasses and bronzes by digestion in nitric acid, or precipitation by ammonium hydroxide after solution in aqua regia. The three elements are then converted to sulphates, the arsenic and antimony reduced to the trivalent state, and the three then separated by fractional distillation and determined by titration. The results for antimony and tin obtained by this method are more accurate than those obtained by so-called direct titration methods. Since the method provides for the isolation of these elements positive identification of very small amounts of these constituents is facilitated.

DETERMINATIONS OF OXYGEN IN ALLOY STEEL

The results of the recent international cooperative study referred to in the preceding item, defined the accuracy and limitations of the methods

in common use for the determination of oxygen in simple steels. However, information on the applicability of these methods to the analysis of alloy steels has not been available heretofore. The determination of oxygen is a difficult problem, even in simple steels, because of the number of oxide compounds and combinations. The analysis of alloy steels involves additional uncertainties because of the probable presence of oxides of the alloying elements that are not in simple steels.

In reporting on recent work in the Bureau's Division of Metallurgy (RP-1115 in the July Journal of Research), J. G. Thompson and V. C. F. Holm conclude that accurate determinations of the total oxygen content of many alloy steels can be made either by the vacuum-fusion method or by a modified hydrogen-reduction method. The limitations of both methods are essentially the same for alloy steels as for simple steels. The common alloying elements or their oxides do not present added difficulty in the operation of either method.

DETERMINATION OF ALUMINUM IN NONFERROUS MATERIALS

Since the presence of aluminum, even in very small amounts, is harmful in certain types of bearing metals, solders, and zinc alloys, it is important to have an accurate method for its determination in such materials. Ammonium aurintricarboxylate is used for this purpose, but existing methods are complicated and uncertain. An improved method for the use of this well-known reagent has been developed by John A. Scherrer and William D. Mogerman of the Bureau's Chemistry Division, and is described in RP1117 which will appear in the Journal of Research for July. The new method is simple and reliable and consists essentially in subjecting a sulphate solution of the alloy to a preliminary electrolysis in a mercury cathode cell to remove interfering elements, and then testing the electrolyte with ammonium aurintricarboxylate. The pink color so produced is compared with standards prepared in the same way.

PREPARATION OF AMMONIUM AURINTRICARBOXYLATE

Very small amounts of aluminum have deleterious effects on many types of nonferrous alloys. In some brasses

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and bronzes it reduces the ductility, increases brittleness, and in other ways acts unfavorably. In a large number of bearing metals, solders, and zinc alloys the American Society for Testing Materials limits the amount of aluminum to less than 0.005 percent. For the reliable performance of the method for the detection and determination of small amounts of aluminum referred to in the preceding item, a dye of uniform and high quality must be available. As a suitable reagent could not be obtained either by purchase or preparation by procedures describes in the literature, a method was devised by John A. Sherrer and W. Harold Smith for the preparation of the ammonium salt of aurintricarboxylate acid, which is satisfactory for use in the test for aluminum. RP1118 in the July Journal of Research should be consulted for the complete report on this work.

CHROMOUS SOLUTIONS FOR ABSORPTION OF OXYGEN IN VOLUMETRIC GAS ANALYSIS

RP1112 in the July Journal of Research describes recent work by Joseph R. Branham of the Bureau's Chemistry Division in the preparation and application of chromous solutions for the absorption of oxygen in volumetric gas analysis. Samples of carbon dioxide-free air and of commercial oxygen were analyzed volumetrically over mercury by absorption in solutions of chromous chloride, chromous sulphate, and alkaline potassium pyrogallate. Acidified and nonacidified solutions of chromous chloride or of chromous sulphate were found to absorb oxygen completely. It was necessary to saturate these solutions with nitrogen and free them of dissolved hydrogen before they were used to determine the oxygen content of mixtures of oxygen and nitrogen. Some of this dissolved nitrogen was later displaced from the chromous solutions, particularly from dilute solutions such as the sulphate, during the analysis of oxygen. The apparent percentages of oxygen in the samples were, therefore, low unless special efforts were made to redissolve this displaced nitrogen at the end of each analysis. This necessary procedure increases the time required for each analysis, and, therefore, no benefit is derived from the speed of the reaction between oxygen and the

chromous solutions. Concentrated acidified solutions of chromous chloride, and perhaps also nonacidified solutions of chromous sulphate, evolve small amounts of hydrogen, the amounts being of the same order of magnitude as the amounts of carbon monoxide which were evolved by some of the solutions of alkaline potassium pyrogallate used in this study.

The sulphate radical in the presence of acidified solutions of chromous sulphate is partially reduced to hydrogen sulfide. Very small amounts of this gas cause serious errors in volumetric analysis over mercury by reacting with the mercury and altering the shape of the menisci in the burette and the manometer. When acidified solutions of chromous chloride or nonacidified solutions of chromous sulphate are prepared by reduction of chromic salts by amalgamated zinc, the zinc must be freed from sulfide (and possibly from sulphate) if hydrogen sulfide is to be avoided.

The sulfur in liquid petrolatum is reduced to hydrogen sulfide by contact with acidified chromous solutions. Liquid petroleum should, therefore, not be used to protect these reagents from air.

Concentrated acidified solutions of chromous chloride will absorb large volumes of oxygen before becoming exhausted. In certain absorption pipettes this capacity toward oxygen is greater than that of alkaline potassium pyrogallate.

In conclusion, it may be stated that the choice between concentrated acidified solutions of chromous chloride and alkaline potassium pyrogallate, as reagents to determine oxygen volumetrically, will depend on many variable conditions. Both reagents, however, are useful and should be chosen in preference to the more dilute solutions of chromous sulphate.

NITROGEN IN VOLUMETRIC GAS ANALYSIS

In the course of the experiments described in the preceding item, to determine the suitability of chromous solutions as reagents for oxygen in gas analysis, the accuracy of the results was found to be affected by the displacement of nitrogen from its subsequent partial re-solution in the reagents. An effect of this kind is to be anticipated with every liquid reagent used for volumetric gas analysis. It

appeared worthwhile, therefore, to make a quantitative study of the effect, both to explain more fully the properties of the chromous solutions and to provide some indication of the magnitude of the error likely to be introduced into gas analyses in general by the solution and liberation of gases supposed to be "inert" toward the reagent used. This work is described in a paper by Joseph R. Branham and Max Sucher, which will be published in the July number of the Journal of Research (RP1113).

A fixed volume of nitrogen was repeatedly bubbled through several air-saturated liquids in absorption pipettes attached to a volumetric gas analysis apparatus, and the volumes of nitrogen which dissolved and of oxygen which were displaced were measured. Measurements made with air, and with nitrogen in contact with the open surfaces of the liquids in the atmospheric arm of the absorption pipettes, showed that measurable volumes of gas passed through these surfaces in both directions. A layer of mineral oil between the solution and the air or nitrogen above its open surface did not prevent this interchange of gases. The amounts of nitrogen which dissolved when nitrogen was bubbled through the solutions until equilibrium was established were used to calculate the approximate solubility of nitrogen in several of the solutions as compared to water. These approximate relative solubilities, water being considered equal to 1, are: $0.4\text{ }M\text{ }K_2Cr_2(SO_4)=0.63$; $4\text{ }M\text{ }CrCl_3=0.28$; and potassium hydroxide (sp gr 1.54 at 20°C) plus 10 percent of water being less than 0.05. These solubilities are used to predict the behavior of nitrogen in solutions of chromous sulphate, and alkaline potassium pyrogallate, when these reagents are used to determine oxygen volumetrically.

The data show that measurable volumes of nitrogen may pass between the gas sample and the reagent, as well as between the reagent and the atmosphere above its surface in the atmospheric arm of the absorption pipette. Volumetric errors may also result from the change of solubility of nitrogen in the reagent with temperature, when heat is liberated during the reaction between oxygen and the reagent. Errors from these three sources are roughly proportional to the solubility of nitrogen in the reagents, and are very small in the case of concentrated solutions of potassium hydroxide or of alkaline potassium pyrogallate.

MEASUREMENT OF SUPERVOLTAGE X-RAYS WITH FREE AIR IONIZATION CHAMBER

X-rays generated by voltages up to 200,000 v have been used in this country and abroad since 1918 in the treatment of cancer, tumors, and other serious diseases. Much difficulty and confusion resulted in the early years from a lack of a suitable physical means to administer the doses in different hospitals. After years of research a suitable and co-ordinated system of dosage was established with a high degree of accuracy and safety. The Bureau, in cooperation with several foreign laboratories, has been instrumental in this work of establishing and maintaining X-ray standards.

Within the past 3 years X-ray voltages have been more than doubled, there being several dozen X-ray plants in this country operating at 400,000 v and some half-dozen at voltages from 600,000 to 1,200,000. With this increase in voltage, entirely new measurement problems have arisen, the solution of which is awaited before these new radiations can be safely utilized to their ultimate limit. To meet this demand a 500-kv X-ray plant has been installed at the Bureau, and will provide a starting point in attacking this problem, although it is generally recognized that at least twice that voltage will ultimately be needed to keep abreast of the clinical demand for X-ray standards.

To measure the X-rays a tube of special design has been so constructed as to avoid the difficulties of standardization ordinarily encountered in hospital installations. One of the world's largest X-ray ionization chambers has also been built with the view of measuring all X-rays from 100,000 to 1,000,000 v. This chamber is of the so-called guarded field type and is contained in a large steel pressure cylinder capable of being operated up to 150 lb/in.² (10 times atmospheric pressure). X-rays pass into this through a thin window and render the air inside electrically conducting, a measure of which gives the X-ray intensity. By operating at high pressures it is possible to avoid some of the main difficulties encountered in other methods. Measurements up to 400,000 v have been carried out and it appears possible for the first time to standardize, accurately, dosage up to

these limits. A complete report on this work by Lauriston S. Taylor, G. Singer, and A. L. Charlton, will be published as RP1111 in the Journal of Research for July.

COMBINATION OF HYDROCHLORIC ACID AND SODIUM HYDROXIDE WITH HIDE, TENDON, AND BONE COLLAGEN

White fibrous connective tissue occurs in high concentration in the skin, tendons, and bones of animals. It has been generally supposed that the tissues from these three sources are identical, although some investigators have concluded that there are significant differences. In a recent investigation by John Beek, Jr., of the Bureau's leather section, the capacities of these materials for combining with acid and with alkali were compared. It was found that they all behave the same in this respect, if account is taken of the effect of the drastic treatment required to isolate the tissue from bones. About three times as much acid as alkali was found, which indicates that the material is basic in character. A direct measurement of the acidity of a solution in contact with the tissue from hide led to the same conclusion. This work is reported more fully in the July number of the Journal of Research (RP1119).

ACCELERATED AGING OF LEATHER IN THE OXYGEN BOMB

For the last 2 years Joseph R. Kanagy of the Bureau's leather section has been investigating the behavior of leather in an oxygen bomb in order to obtain data to be used in developing an accelerated aging test. Such a test is important in the development of leathers for long service, as, for example, bookbindings and upholstery leathers. It would also improve testing and save time in research.

The results of a previous investigation were published in Technical News Bulletin 242 (June 1937). In that study samples of chestnut- or quebracho-tanned leather were dried in an oven at 100° C. for 24 hours and then exposed in the bomb to an atmosphere of oxygen initially at 100 lb./in.² and aged at 100° C. for 7 days. The results compared favorably with those obtained when similar leathers were aged under normal conditions for 10

years. The present investigation is a continuation of this study. Rawhide and various tannages of leather were exposed in the oxygen bomb under the conditions mentioned above. The amounts of carbon dioxide and water evolved from some of the leathers and rawhide, when heated in a stream of oxygen at 100° C., were also determined, and these results for the vegetable-tanned leathers were related to their stabilities in the oxygen bomb.

The results indicate that such factors as stability of the tannins to oxidation, tanning properties of the tanning materials, and conditions which weaken the hide substance during the tanning process are reflected in the results obtained in the oxygen bomb. The mechanism of the deterioration occurring in the bomb also appears to be similar to that occurring under normal aging conditions. For these reasons it is concluded that aging under the accelerated conditions in the oxygen bomb should give valuable indications as to the aging properties of a leather.

PERMEABILITY OF WRAPPING MATERIALS

Wrapping and packaging materials impervious to moisture are demanded for many purposes, including protection of food products and other hygroscopic articles of commerce. It is, therefore, important to have adequate testing methods for determining whether or not a material is sufficiently resistant to the passage of moisture to serve a given purpose.

A contribution has recently been made by F. T. Carson of the Bureau's paper section toward the improvement of test methods for determining permeability to water vapor. A simple and effective way has been devised for affixing a specimen to a dish or permeability cell using equipment commonly found in the laboratory, or that can be easily improvised. The specimen is sealed to the cell in a positive manner by means of wax, and by the use of a templet the area to be exposed is made definite and clear-cut. The method is adaptable to various forms of dishes and cells, and allows the specimen to be sealed in at any desired height in the cell, thus eliminating certain common errors.

TENTATIVE TEST FOR GLAZE SOLUBILITY

The modern demand for bright colors has resulted in the development of

ceramic tableware in monochrome reds, yellows, greens, and blues, which must of necessity be matured at comparatively low temperatures, using lead oxide as glaze constituent. The possibility exists of inadvertently placing on the market a ware coated with a glaze of such solubility as to introduce into foods a detrimental quantity of lead. To forestall this, the following tentative test and limit for lead was decided upon, after conference with representatives of the manufacturers and of the United States Food and Drug Administration:

Treatment.—Place 150 ml of white (redistilled) vinegar (5 percent acidity) in a 250 ml Pyrex beaker, bring to boiling and immediately pour into a cup under test, cover with a clean watch glass and let stand for 30 minutes in a place protected from drafts, and at "room temperature" (between 20° and 30° C.).

Test.—After treatment, transfer the contents of the cup to a 250 ml Pyrex Erlenmeyer flask and cool to approximately room temperature. Pass a stream of H₂S into this solution for 3 to 4 minutes and compare the depth of color developed with that of standards made up in 250 ml Erlenmeyer flasks containing 150 ml of the white vinegar to which 2, 4, and 6 parts per million of Pb have been added, in the form of lead acetate or nitrate, and which have been gassed with H₂S. The standards are stable for only a couple of hours. Precipitation or coagulation of the sulfides will take place if large amounts are present. Pure acetic acid should not be substituted for the vinegar.

Limit.—Any glaze from which the above treatment has dissolved more than 2 parts of lead per 1,000,000 parts of vinegar should be considered as a possible hazard to health.

DENSITY-COMPOSITION RELATIONS OF SOME SODA-POTASH-SILICA GLASSES

In Technical News Bulletin 179 (March 1932) certain relations between density and composition of some soda-silica glasses were tentatively suggested. Since that report, the number of soda-silica glasses has been greatly increased and their densities, together with the viscosities of many potash-silica and soda-potash-silica glasses made subsequently, were determined after the glasses had been heat-treated by a method different from that previously

used. The results of the completed study necessitate a revision of the former conclusions.

It has been found that, except for density changes incident to changes in composition, the density of any of these glasses is determined largely by the rate of cooling through the "critical range" (range of rapid change in expansion); the greater this rate, the lower the density, irrespective of any other heat treatment the glass may receive outside this range. Accordingly, all the glasses were heated simultaneously in a large furnace which was then cooled at a constant rate between two temperatures (540° to 400° C.), so chosen as to include the critical range of every glass. Therefore, it may be said that all the glasses received comparable heat treatment.

When, for either the soda-silica or potash-silica glasses, specific volume (reciprocal of density) is plotted against weight-percentage of silica, a definite change in the slope of the line fitting the plotted points becomes apparent at silica percentages corresponding to those indicated by Kracek as eutectic compositions. Furthermore, between these percentages the line is relatively straight. The abrupt changes in slope indicate that the data can most simply be evaluated as straight lines intersecting at or near the eutectic compositions.

Similarly, the relation between specific volume and composition for the soda-potash-silica glasses may be represented on a triordinate diagram by a surface consisting of several relatively flat sections, which may be evaluated as planes, the intersections of which correspond approximately to the boundary curves of Kracek's equilibrium diagram for this system.

EFFECT OF CURING TEMPERATURE ON YOUNG'S MODULUS OF CONCRETE

The construction, during the past 10 years, of a large number of concrete dams has stimulated a study of the fundamental properties of hydraulic and other cements for use in mass concrete, including the low-heat cement, used with eminent success in the Pine Canyon and Boulder Dams.

The chief advantage claimed for this cement was its low heat liberation during hydration, as it was reasoned that this would result in a lower temperature rise within the mass and consequently less contraction during cooling

after the concrete had hardened. Thus, the number of cracks, which often develop as the mass cools, should be eliminated or greatly reduced.

Later developments have indicated that there are other properties, besides the low heat of hydration, which contribute to the success of this cement. To secure further information along this line, E. A. Pisapia and F. B. Hornbrook have determined the effect of curing temperature on the modulus of elasticity of concretes made with several types of portland cements.

Six flexure specimens, 3 by 4 by 32 in., were made with each of the following five types of cements: High-early-strength, standard portland, modified portland, portland-pozzolan, and low-heat cements. Two specimens for each cement were both fabricated and cured (in water) at each of the three temperatures, 40, 70, and 100° F. The mix used was 1:2.4:3.6 by weight and the C/W was 1.63. The results (average of two specimens) obtained for the modulus of elasticity at 28 days are as follows:

Cement	Modulus of elasticity (E), 10 ⁶ lb/in. ²			Change in (E), 10 ⁶ lb/in. ²		Modulus of rupture at 1 month, lb/in. ²
	40° F	70° F	100° F	40° to 70° F	70° to 100° F	70° F
High-early-strength	4.32	4.82	5.11	0.50	0.29	810
Standard portland	4.03	4.36	4.67	.33	.31	690
Modified portland	4.10	4.50	4.82	.40	.32	740
Portland pozzolan	3.45	4.13	4.36	.68	.23	610
Low heat	2.55	3.31	4.34	.76	1.03	520

It can be seen that the low heat cement had a very low modulus at the lowest curing temperature, but the modulus increased rapidly with increase in curing temperature, and at 100° F. was of the same order of magnitude as the modulus of the other cements, except that of the high-early-strength cement.

Although no definite conclusions can be drawn from such limited tests, the data presented indicate that under conditions of curing found in mass concrete, the modulus of elasticity of the low-heat cements would not be greatly different from the modulus of the standard or "modified" cements.

J. H. DELLINGER AND G. W. VINAL RECEIVE AWARDS

At the convention of the Institute of Radio Engineers in New York, on June 16, the Institute's Medal of Honor was awarded to Dr. J. H. Dellinger, chief of the Bureau's radio section, with the accompanying citation:

"To Dr. John Howard Dellinger—for his contributions to the development of radio measurements and standards, his researches and discoveries of the relation between radio-wave propagation and other natural phenomena, and his leadership in international conferences contributing to world-wide cooperation in telecommunications."

At the summer convention of the American Institute of Electrical Engineers, which was held in Washington, June 20 to 24, the Gaston Planté Medal of the Société Française des Electriciens was presented by the Ambassador of France to Dr. George Wood Vinal, chief of the Bureau's section which deals with electrical batteries. Dr. Vinal is the first to receive this medal. It was established in 1935 and is to be awarded at intervals of 3 years to men whose work shall have constituted an important contribution to industry in the field of storage batteries, of dry cells, or of electrochemistry in general.

ERRORS IN TECHNICAL NEWS BULLETIN

The following errors have been noted in the June 1938 number of the Technical News Bulletin:

Page 51.—The number of the Bulletin should be "254" instead of "305." The titles "Suitability of various plastics for use in aircraft dopes" and "Mimeographed material" should be deleted from the table of contents.

Page 54.—The title of the first article should read "Heats of hydration and transition of calcium sulphate." In the nineteenth line of the item entitled "Gas calorimeter tables," the word "more" should be deleted.

NEW AND REVISED PUBLICATIONS ISSUED DURING JUNE 1938

Journal of Research *

Journal of Research of the National Bureau of Standards, volume 20, number 6, June 1938 (RP1102 to RP1109, inclusive). Price 25 cents. Annual subscription beginning July 1, 12 issues, \$3.50.

Journal of Research of the National Bureau of Standards, title page, corrections, and contents to volume 19, July to December 1937 (RP1006 to RP1058, inclusive). Free on application to the Bureau.

Research Papers *

[Reprints from March and April 1938 Journal of Research]

RP1078. An absolute electrometer for the measurement of high alternating voltages. Herbert B. Brooks, Francis M. Defandorf, and Francis B. Silsbee. Price 15 cents.

RP1079. A transformer method for measuring high alternating voltages and its comparison with an absolute electrometer. Francis B. Silsbee and Francis M. Defandorf. Price 10 cents.

RP1080. Reference tables for iron-constantan and copper-constantan thermocouples. Wm. F. Roeser and Andrew I. Dahl. Price 5 cents.

RP1081. Magnetic method for measuring the thickness of nonmagnetic coatings on iron and steel. Abner Brenner. Price 5 cents.

RP1082. A method for the investigation of upper-air phenomena and its application to radio meteorography. Harry Diamond, Wilbur S. Hinman, Jr., and Francis W. Dunmore. Price 10 cents.

RP1083. Photoelastic determination of stresses around a circular inclusion

in rubber. Wilfred E. Thibodeau and Lawrence A. Wood. Price 5 cents.

RP1084. Fire-clay ladle sleeves. Raymond A. Heindl and George J. Cooke. Price 5 cents.

RP1085. Refractive index and dispersion of distilled water for visible radiation, at temperatures 0° to 60° C. Leroy W. Tilton and John K. Taylor. Price 15 cents.

RP1088. Water as a reference standard for ebulliometry. Wojciech Swietoslowski and Edgar Reynolds Smith. Price 5 cents.

Simplified Practice Recommendations*

R146-38. Corrugated and solid fiber boxes for canned fruits and vegetables. (Supersedes R146-33.) Price 5 cents.

Technical News Bulletin *

Technical News Bulletin 254, June 1938. Price 5 cents. Annual subscription, 50 cents.

MIMEOGRAPHED MATERIAL

Letter Circulars

Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.

LC517. Motorists' manual of weights and measures.

LC520. Automobile costs.

LC521. Corrosion and protection of underground tanks and burial vaults.

LC523. Lubrication: Publications by staff of the National Bureau of Standards, 1910-1937.

LC524. Aeronautical publications by members of the staff of the National Bureau of Standards. (Supersedes LC325.)

LC525. Color harmony—an annotated bibliography. (Supersedes LC356.)

LC526. Color charts—a descriptive list. (Supersedes LC481.)

LC527. Artificial abrasives and abrasive products.

* Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, \$3.50 per year (United States and its possessions, and Canada, Colombia, Cuba, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Newfoundland (including Labrador), Panama, and Venezuela); other countries, 70 cents and \$4.50, respectively.

**RECENT BUREAU ARTICLES
APPEARING IN OUTSIDE PUBLICATIONS²**

Le séismomètre Galitzine. Frank Wenner and H. E. McComb. Extrait des publications du Bureau Central Séismologique International (Strasbourg, France), série A: Travaux scientifiques, fascicule 15 (1937).

Recherches a la plate-forme d'essai sur les séismomètres téléseismiques. H. E. McComb and Frank Wenner. Extrait des publications du Bureau Central Séismologique International, série A: Travaux scientifiques, fascicule 15 (1937).

Characteristics of the ionosphere at Washington, D. C., March 1938. T. R. Gilliland, S. S. Kirby, and N. Smith. Proc. Inst. Radio Engrs. (33 W. 39th St., New York, N. Y.) 26, 640 (May 1938).

The corrosion and protection of pipe lines in the United States of America. K. H. Logan. Reprinted from "The Science of Petroleum" (Oxford University Press, Oxford, England) p. 747 (1938).

Tests of flameproofed textiles by several methods. Report of Committee on Fireproofing and Preservation

Treatments, Natl. Fire Protection Assn. (60 Batterymarch St., Boston, Mass.) 4 (1938).

Minimum perceptible colorimetric purity as a function of dominant wave length. Irwin G. Priest and Ferdinand G. Brickwedde. J. Optical Soc. Am. (Cornell University, Ithaca, N. Y.) 28, 133 (1938).

Suitability of various plastics for use as airplane dopes. Gordon M. Kline and C. G. Malmberg. (Ind. Eng. Chem., Mills Bldg., Washington, D. C.) 30, 542 (May 1938).

Square solder wire. C. E. Waters. Laboratory and shop notes section, Rev. Sci. Instr. (Cornell University, Ithaca, N. Y.) 9, 139 (April 1938).

The theory of impact testing: Influence of temperature, velocity of deformation, and form and size of specimen on work of deformation. D. J. McAdam, Jr., and R. W. Clyne. Preprint 30, Am. Soc. Testing Materials (260 S. Broad St., Philadelphia, Pa.) (1938).

A further study of the water penetrability of clay and shale building brick. J. W. McBurney and A. R. Eberle. Bul. Am. Ceramic Soc. (2525 N. High St., Columbus, Ohio) 17, 210 (May 1938).

Supplement to a compilation of phase-rule diagrams of interest to the ceramic and silicate technologist. E. P. Hall and H. Insley. J. Am. Ceramic Soc. 21, 113 (April 1938).

²These publications are not obtainable from the Government. Requests should be sent direct to the publishers.



